

## Claims

- 1           1.       A process, comprising: a) reacting a an alkoxysilane, an  
2 (epoxy)alkoxysilane, and a fluorinated alkoxysilane to form a fluorinated sol-gel  
3 polymer; and b) reacting a nonlinear optical chromophore comprising a donor, a  $\pi$ -  
4 bridge, an acceptor, and at least one alkoxysilyl group with the fluorinated sol-gel  
5 polymer to form a nonlinear optical fluorinated sol-gel polymer.
- 1           2.       The process of Claim 1, wherein the alkoxy group of one or more of the  
2 alkoxysilane, the (epoxy)alkoxysilane, the (fluoroalkyl)alkoxysilane, or the alkoxysilyl  
3 group of the nonlinear optical chromophore is independently selected from the group  
4 consisting of methoxy, ethoxy, propoxy, isopropoxy, butoxy, and any combination  
5 thereof.
- 1           3.       The process of Claim 1, wherein the alkoxysilane is a tetraalkoxysilane.
- 1           4.       The process of Claim 1, wherein the (epoxy)alkoxysilane further  
2 comprises one alkyl group.
- 1           5.       The process of Claim 1, wherein the (epoxy)alkoxysilane comprises two  
2 epoxy groups.
- 1           6.       The process of Claim 1, wherein the (epoxy)alkoxysilane comprises an  
2 epoxyalkyl group, a epoxycycloalkyl group, or any combination thereof.
- 1           7.       The process of Claim 6, wherein the (epoxy)alkoxysilane comprises a 3-  
2 (2,3-epoxypropoxy)propyl group, a 5,6-epoxyhexyl group, a 2-(3,4-  
3 epoxycyclohexyl)ethyl group, or any combination thereof.
- 1           8.       The process of Claim 1, wherein the fluorinated alkoxysilane comprises a  
2 fluorinated group including up to about 20 carbon atoms.

1           9.       The process of Claim 8, wherein the fluorinated group is selected from the  
2 group consisting of a 3,3,3-trifluoropropyl group, a 3-(heptafluoroisopropoxy)propyl  
3 group, a pentafluorophenyl, pentafluoro-phenylpropyl group, a perfluoro-1,1,2,2-  
4 tetrahydrohexyl group, a perfluoro-1,1,2,2-tetrahydrooctyl group, a perfluoro-1,1,2,2-  
5 tetrahydrodecyl group, a perfluoro-1,1,2,2-tetrahydrododecyl group, a perfluoro-1,1,2,2-  
6 tetrahydrododecyl group, and any combination thereof.

1           10.      The process of Claim 1, wherein the fluorinated alkoxysilane comprises  
2 two fluoroalkyl groups.

1           11.      The process of Claim 1, wherein the fluorinated alkoxysilane comprises a  
2 fluorocycloalkyl group.

1           12.      The process of Claim 1, wherein the molar ratio of the fluorinated  
2 alkoxysilane to the (epoxy)alkoxysilane is greater than about 0.1 to 4.

1           13.      The process of Claim 1, wherein the weight percent of the nonlinear  
2 optical chromophore in the fluorinated sol-gel polymer is about 10 weight percent to  
3 about 50 weight percent.

1           14.      The process of Claim 1, comprising catalyzing the reaction of the  
2 tetraalkoxysilane, the (epoxy)alkoxysilane, and the fluorinated alkoxysilane with a  
3 catalyst comprising deuteriochloric acid in deuterium oxide.

1           15.      The process of Claim 1, further comprising c) forming a thin film  
2 comprising the nonlinear optical fluorinated sol-gel on a substrate; and d) poling the  
3 nonlinear optical fluorinated sol-gel to form an electro-optic fluorinated sol-gel.

1           16.      The process of Claim 15, wherein forming the thin film comprises spin  
2 coating, dip coating, or brushing.

1           17.      The process of Claim 15, wherein the substrate further comprises a  
2 cladding material, the cladding material having an index of refraction lower than the  
3 index of refraction of the electro-optic fluorinated sol-gel.

1           18.     The process of Claim 17, wherein the cladding material comprises a  
2 polymer.

1           19.     The process of Claim 1, wherein the alkoxyethyl group of the nonlinear  
2 optical chromophore comprises a trialkoxyethyl group.

1           20.     The process of Claim 1, wherein the alkoxyethyl group of the nonlinear  
2 optical chromophore is attached to the donor.

1           21.     The process of Claim 1 wherein the alkoxyethyl group of the nonlinear  
2 optical chromophore is attached to the acceptor.

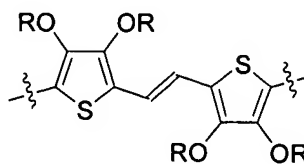
1           22.     The process of Claim 1, wherein the nonlinear optical chromophore  
2 comprises two alkoxyethyl groups.

1           23.     The process of Claim 22, wherein the two alkoxyethyl groups are attached  
2 to the donor.

1           24.     The process of Claim 23, wherein one alkoxyethyl group is attached to the  
2 donor and one alkoxyethyl group is attached to the acceptor.

1           25.     The process of Claim 1, wherein the  $\pi$ -bridge comprises a thiophene ring  
2 having oxygen atoms bonded directly to the 3 and 4 positions of the thiophene ring.

1           26.     The process of Claim 25, wherein the  $\pi$ -bridge has the structure



3           wherein R is an alkyl group, a heteroalkyl group, an aryl group, or a heteroaryl  
4 group.

1           27. A composition prepared according to the process of claim 1 or 15.

1           28. An electro-optic device comprising the composition of claim 27.

1           29. The electro-optic device of claim 28, including a Mach-Zehnder modulator, a  
2   directional coupler, or a micro-ring resonator.